

**REMARKS**

Claims 1, 5, and 8 have been amended to resolve issues raised by the Examiner under 35 U.S.C. 112, second paragraph. Claim 1 has also been amended to incorporate the recitations of claim 4, and claim 4 has been canceled. Claim 5 has also been amended based on the disclosure at the top of page 17 in the specification. Claim 9 has been amended to make an editorial change. Claim 12 has been amended based on the disclosure at page 18, lines 6-11 in the specification.

Entry of the above amendment is respectfully requested.

**Rejection under 35 U.S.C. 112, Second Paragraph**

On page 2 of the Office Action, claims 1-9 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite.

**The Examiner's Position**

The Examiner's position is basically that the recitations "high density" at claim 1, line 6 and claim 5, line 6 and "high purity" at claim 1, line 8 and claim 8, line 2 are indefinite because they lack basis for comparison.

**Applicants' Response**

In response, and to expedite allowance, Applicants have amended the claims to delete the recitations at issue. Accordingly, Applicants submit that the present claims satisfy the requirements of 35 U.S.C. 112, second paragraph, and withdrawal of this rejection is respectfully requested.

**Anticipation Rejection of Claims 1, 2 and 8**

On page 2 of the Office Action, claims 1, 2 and 8 are rejected under 35 U.S.C. 102(b) as being anticipated by Mori et al. (U.S. Pat. 6,136,214).

In response, Applicants submit initially that regarding amended claim 1 and the claims dependent thereon, there is no disclosure or suggestion in the cited art about the specific radical generating method of the present invention for selectively generating  $\text{CF}_3$  radicals and preparing  $\text{CF}_3$  radicals with high density and high purity, especially in which the bias voltage of 480 to 600 V is applied to the carbon material to selectively form  $\text{CF}_3$  radical. Further, using an etching gas containing such  $\text{CF}_3$  radicals, it is possible to improve the etching rate of a silicon oxide film ( $\text{SiO}_2$  film) and also to improve the efficiency of plasma etching process (page 8, lines 16 to 23, page 15, line 24 to page 16, line 3, page 14, lines 5 to 7 and Examples). As described above, in the absence of disclosure or suggestion in the cited art about the specific radical generating method and the obtainable excellent effect of the present invention, the skilled person would have no motivation to achieve the present invention on the basis of the cited art.

In particular, it is noted that Mori discloses at col. 6, line 66 to col. 7, line 3 that Fig. 3 shows measurements of the densities of radicals  $\text{CF}_1$ ,  $\text{CF}_2$  and  $\text{CF}_3$  when a negative DC voltage is applied to the radical control material of carbon in the  $\text{CF}_4$  gas plasma and that  $\text{CF}_3$  decreases as the applied voltage increases. Also, it is noted that Fig. 3 shows a voltage range from 0 to -150 V, and col. 7, lines 35-36 refers to an applied voltage of around  $10^2$  volt.

In view of the above-noted disclosure in Mori, it is submitted that the recitation of "the bias voltage of 480 to 600 V" based on the disclosure at page 14, lines 4-5 and the recitations of claim 4 distinguish the claimed invention from the cited art. Indeed, it is submitted that Mori teaches away from the 480 to 600 V range for generating high purity  $\text{CF}_3$  by teaching lower

voltages and by teaching that  $\text{CF}_3$  decreases as applied voltage increases, such that Mori does not anticipate or even render obvious the amended invention.

Thus, Applicants submit that the present invention is not anticipated by (or obvious over) Mori, and withdrawal of this rejection is respectfully requested.

### **Obviousness Rejection of Claims 3 and 4**

On page 4 of the Office Action, claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mori et al. (U.S. Pat. 6,136,214) in view of Ohmi (U.S. Pat. 5,272,417) or Celestino et al. (U.S. Pat. 4,579,618) or Gorin (U.S. Pat. 4,464,223).

In response, Applicants again submit initially that regarding amended claim 1 and the claims dependent thereon, there is no disclosure or suggestion in the cited art about the specific radical generating method of the present invention for selectively generating  $\text{CF}_3$  radicals and preparing  $\text{CF}_3$  radicals with high density and high purity, especially in which the bias voltage of 480 to 600 V is applied to the carbon material to selectively form  $\text{CF}_3$  radical. Further, using an etching gas containing such  $\text{CF}_3$  radicals, it is possible to improve the etching rate of a silicon oxide film ( $\text{SiO}_2$  film) and also to improve the efficiency of plasma etching process (page 8, lines 16 to 23, page 15, line 24 to page 16, line 3, page 14, lines 5 to 7 and Examples). As described above, in the absence of disclosure or suggestion in the cited art about the specific radical generating method and the obtainable excellent effect of the present invention, the skilled person would have no motivation to achieve the present invention on the basis of the cited art.

Further, as discussed above, it is again submitted that Mori teaches away from the 480 to 600 V range for generating high purity  $\text{CF}_3$  by teaching lower voltages and by teaching that  $\text{CF}_3$

decreases as applied voltage increases, such that the cited art does not render obvious the amended invention.

Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested.

#### **Obviousness Rejection of Claims 5, 6 and 9**

On page 5 of the Office Action claims 5, 6 and 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mori et al. (U.S. Pat. 6,136,214) in view of Tanaka et al. (U.S. Pat. 6,590,179).

In response, Applicants submit that with respect to amended claim 5 and the claims dependent thereon, there is no disclosure or suggestion in the cited documents about the specific radical generating method of the present invention, namely the radical generating method by which the ratio of CF<sub>3</sub> radicals, CF<sub>2</sub> radicals and CF radicals is arbitrarily regulated by controlling the target bias voltage of not less than 700 V applied to the carbon material while measuring the infrared absorption spectrum of radicals generated inside the chamber. Further, the radical generating method can generate radicals containing CF<sub>3</sub> radicals, CF<sub>2</sub> radicals and CF radicals in an arbitrary ratio (page 14, line 13 to page 15, line 4 and Examples). As a result, the SiO<sub>2</sub> etching selectivity is improved in etching the SiO<sub>2</sub>/resist film, and a perpendicular contact hole can be formed in the substrate having the SiO<sub>2</sub>/resist film (page 17, lines 7 to 11, page 22, lines 19 to 22 and Examples).

Therefore, by the same token as amended claim 1, the skilled person would have no motivation to achieve the specific radical generating method described in amended claim 5 on

the basis of the cited documents because there is no disclosure or suggestion in the cited documents about the radical generating method and the obtainable excellent effects.

In particular, it is noted that in regard to this embodiment of the present invention, the present application discloses that the target bias voltage is usually not less than 700 V (see the top of page 17 in the present application), which is much larger than that used in Mori (the reference that the Examiner relies upon in connection with the voltage). Accordingly, independent claim 5 has been amended to recite that the target bias voltage is not less than 700 V, and thus it is submitted that Mori in view of Tanaka neither teaches nor suggests the invention as recited in the amended claims.

Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested.

#### **Obviousness Rejection of Claim 7**

On page 6 of the Office Action, claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mori et al. in view of Tanaka et al. as applied to claims 5, 6 and 9 above, and further in view of Ohmi (U.S. Pat. 5,272,417) or Celestino et al. (U.S. Pat. 4,579,618) or Gorin (U.S. Pat. 4,464,223).

In response, Applicants submit that Ohmi, Celestino et al., and Gorin do not make up for the deficiencies of Mori and Tanaka as discussed, and thus claim 7, which depends from claim 5, is not obvious over the cited art.

Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested.

### **Obviousness Rejection of Claims 10 and 11**

On page 8 of the Office Action, claims 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mori et al. (U.S. Pat. 6,136,214) in view of Ohmi (U.S. Pat. 5,272,417) or Celestino et al. (U.S. Pat. 4,579,618) or Gorin (U.S. Pat. 4,464,223) and Tanaka et al. (U.S. Pat. 6,590,179).

In response, Applicants submit that the radical generating apparatus described in the claim 10 is suitable for performing the specific radical generating methods of the present invention for selectively generating  $\text{CF}_3$  radicals and preparing  $\text{CF}_3$  radicals with high density and high purity (page 8, line 16 to page 9, line 9, page 11, line 3 to page 12, line 20, page 14, lines 5 to 7 and Examples) and further for generating radicals containing  $\text{CF}_3$  radicals,  $\text{CF}_2$  radicals and  $\text{CF}$  radicals in an arbitrary ratio (page 14, line 13 to page 15, line 4 and Examples). Also the etching apparatus described in the claim 11 is suitable for performing the specific etching methods of the present invention for improving the efficiency of plasma etching process, for selectively etching a silicon oxide film in the  $\text{SiO}_2$ /resist film and further for plasma etching with high accuracy (page 8, line 16 to page 9, line 9, page 11, line 3 to page 12, line 20 and Examples). In the absence of disclosure or suggestion in the cited documents about the specific radical generating apparatus or the specific etching apparatus and the obtainable excellent effects of the present invention, the skilled person would have no motivation to achieve the apparatuses of the present invention on the basis of the cited documents.

Further, it is submitted that Tanaka does not include a specific teaching with respect to an electrode or electrodes, so it is not clear how the Examiner can allege that the laser in Fig. 1 of Tanaka would pass between two electrodes.

Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested.

### **Obviousness Rejection of Claim 12**

On page 10 of the Office Action, claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mori et al. (U.S. Pat. 6,136,214).

In response, Applicants submit that with respect to amended claim 12, the range of the F<sub>2</sub> gas concentration in the mixed gas used in the present invention and the obtainable superior effects are clearly described in the page 17, line 12 to page 19, line 1 of the present application.

It is submitted that the invention as recited in claim 12 is not obvious because it provides unexpectedly superior results, as can be seen from Fig. 5 in the present application.

In addition, it is noted that in regard to this embodiment of the present invention, the present application discloses that the target bias voltage is preferably not less than 480 V (see page 18, lines 6-11 in the present application), which is much larger than that used in Mori (the reference that the Examiner relies upon in connection with the voltage). Accordingly, Applicants have amended independent claim 12 to recite that the target bias voltage is not less than 480 V, and thus it is submitted that Mori in view of Tanaka neither teaches nor suggests the invention as recited in the amended claims.

Thus, Applicants submit that the present invention is not obvious over the cited art combination, and withdrawal of this rejection is respectfully requested.

**Conclusion**

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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